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(54) **PROCESS FOR CONDUCTING ORGANIC REACTIONS IN A STANDALONE AND AFFORDABLE LABORATORY SCALE SOLAR PHOTO THERMOCHEMICAL REACTOR**

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See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2010/0139648 A1* 6/2010 Bourke F24J 2/0023 126/681

FOREIGN PATENT DOCUMENTS

WO WO 2012/156768 A1 11/2012

OTHER PUBLICATIONS

Dinda, et al. 2012 "Clean synthesis of crystalline p-nitrobenzyl bromide from p-nitrotoluene with zero organic discharge" *RSC Advances* 2(16); 6645-6649.

(Continued)

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(57) **ABSTRACT**

A process conducts organic reactions in a standalone laboratory scale solar photo thermo chemical reactor. For organic reactions require elevated temperature, light and mechanical agitation, all three energy forms can be simultaneously derived from solar radiation. Organic synthesis, such as bromination of toluene derivatives (benzylic bromination), bromination of cyclic acyclic hydrocarbon and oxidative cyclization of N-phenylethyl benzamide through bromination were successfully conducted in such reactors.

12 Claims, 5 Drawing Sheets